Before The
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In The Matter Of	)	
Biennial Regulatory Review – Amendment of Parts 1, 22, 24, 27, and 90 to Streamline and Harmonize Various Rules Affecting Wireless Radio Services	)	WT Docket No. 03-264

To: The Commission

COMMENTS OF QUALCOMM INCORPORATED
IN RESPONSE TO FURTHER NOTICE OF PROPOSED RULEMAKING

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QUALCOMM Incorporated ("QUALCOMM") hereby submits its Comments in the above-captioned proceeding in response to the Further Notice of Proposed Rule Making ("FNPRM"), FCC 05-144, released August 9, 2005.

I. Summary

The FNPRM seeks comment on a number of questions on the details of a proposal made in this proceeding by CTIA for changes to the broadband PCS radiated power limits. See FNPRM at para. 51. CTIA has proposed that the rule limiting the average EIRP of broadband PCS base stations, Section 24.232 of the Commission's Rules, be amended to allow base stations with an antenna height of up to 300 meters above average terrain to the larger of (i) 1640 watts (3280 watts in rural areas) per carrier or (ii) 3280 watts per MHz (6560 watts in rural areas). Id. This proposal, if adopted, would add a spectral density feature to the current rule to permit base stations employing wider bandwidth technologies to increase their

power, while allowing base stations based on the narrow emission bandwidth technologies to remain subject to the present limit. Id. Among the issues on which the FNPRM seeks comment is whether the Commission should specify base station power in terms of average power, as CTIA has proposed, and, if the Commission decides to adopt that proposal, whether the Commission should also include a limit on the peak to average ratio to prevent interference. Id. at para. 70.

QUALCOMM supports the CTIA proposal to add a spectral density feature to the base station power rule. As QUALCOMM has maintained throughout this proceeding, a base station power rule that is expressed in terms of power per carrier discriminates against wider bandwidth technologies, such as CDMA and WCDMA, which use fewer carriers per MHz. The narrower bandwidth technologies, such as GSM and TDMA, can use far more carriers per MHz than CDMA and WCDMA. For example, For example, with a reuse of one, a TDMA network can use 160 times the number of carriers per MHz that a WCDMA network can use, and a GSM network can use more than five times the number of carriers per MHz than a CDMA network can use. Indeed, future air interfaces designed to achieve even higher data rates are likely to use wider bandwidth channels.

The Commission's base station power rule should not favor or disfavor any air interface. Adoption of a spectral density-based limit, as CTIA has proposed, will achieve technology neutrality, and at the same time, CTIA's proposal ensures that the narrower bandwidth technologies are not disadvantaged in any way. Moreover, a spectral density-based power limit addresses the Commission's fundamental

regulatory concern in setting a power limit—preventing interference. To limit power solely on the basis of power per carrier fails to address this concern. For all of these reasons, QUALCOMM believes that the Commission should adopt CTIA's proposal.

Furthermore, QUALCOMM believes that the Commission's PCS base station power limit should be expressed in terms of average power, and that the Commission should not impose a limit on the peak to average ratio. Imposing a limit on the peak to average ratio is not necessary and is not likely to result in any reduced potential for interference. The peak to average ratio of a CDMA base station's transmit signal is similar to the peak to average ratio of a Gaussian noise, and thus, is at a level similar to most other noise encountered by any victim receiver. Limiting the peak to average ratio to a level less than Gaussian noise would reduce the downlink capacity of a CDMA base station without significantly reducing the impact on victim receivers. If the peak to average ratio is high for a particular air interface, the base station's average power would need to be reduced anyway in order to meet the Commission's out-of-band emission limits.

Moreover, it is impossible to have a constant envelope (zero peak to average ratio) band limited waveform. As far as we know, all wideband waveforms envisioned for high data rate services are very tightly band limited and cannot have a constant envelope. On the other hand, even though a waveform with a constant envelope does not spread out when it overloads a receiver, it cannot be band limited A waveform with a constant envelope does not spread out when it starts to overload

a receiver, and as a result, even if the peak to average ratio is zero, interference at a given frequency offset will not be significantly different from the level of interference that would be caused with a higher peak to average ratio.

QUALCOMM believes that the Commission's base station power rule should regulate the base station's average power while transmitting, which would disallow averaging in the off times of a gated waveform. Such a limit would sufficiently protect victim receivers, without impairing the transmission capacity of CDMA base stations.

II. Background

QUALCOMM is a world leader in developing innovative digital wireless communications technologies and enabling products and services based on the digital wireless communications technologies that it develops. QUALCOMM has developed core technology known as code division multiple access ("CDMA"). This technology has been incorporated into standardized wireless technologies deployed by wireless carriers in the United States and around the world, including cdmaOne, the second generation (2G) version of CDMA, and CDMA2000, the third generation (3G) version of CDMA. Virtually all third generation ("3G") wireless products and services are based on some form of CDMA.

The 3G CDMA technologies include CDMA2000, which operates on 1.25 MHz channels, WCDMA (also known as wideband CDMA or UMTS), which operates on 5 MHz channels, and TD-SCDMA, which is a TDD-based CDMA technology. CDMA2000 includes both 1xRTT and 1xEV-DO, both of which enable carriers to provide high speed, advanced 3G data services in a relatively narrow swath of spectrum. WCDMA technology permits GSM-based networks to upgrade so as to be able to provide offer advanced, high speed 3G data services in a wider swath of spectrum, and these networks can be upgraded further to high speed downlink packet access ("HSDPA") technology, which will enable them to achieve even faster data rates.

A significant difference between CDMA and WCDMA networks as opposed to TDMA and GSM networks relates to the width of the channels that such networks

use. As already noted, CDMA networks use 1.25 MHz channels, and WCDMA networks use 5 MHz channels, even wider. By contrast, TDMA networks use 30 KHz channels; and, GSM networks use 200 KHz channels. Consequently, GSM and TDMA networks use much narrower channels, and thus can deploy a greater number of carriers per MHz, than the CDMA and WCDMA networks, which nevertheless achieve much faster data rates and much greater voice capacity in the same total allocation of spectrum.

CDMA is proliferating at a rapid pace, here in the United States and around the world. In particular, wireless carriers all over the world are deploying 3G CDMA (either CDMA2000 or WCDMA), and subscribers are migrating to these networks at a rapid pace. 3G CDMA has been deployed by a total of 166 carriers, which are based in the United States and 74 other countries around the world. 122 of these carriers have reported that they already have a total of over 222 million subscribers for 3G CDMA services. Operators in the United States and elsewhere around the world who have deployed 3G CDMA have experienced dramatic and rapid growth in both in terms of numbers of subscribers and average revenue per subscriber.

Moreover, QUALCOMM broadly licenses CDMA technology to over 100 leading handset and infrastructure equipment manufacturers around the world. At present, there are 46 vendors who have manufactured 777 different 3G device models that are now commercially available in the United States and elsewhere

around the world. These devices include a wide array of wireless phones, PCMCIA cards, PDAs, and the like.

III. The Commission Should Adopt CTIA's Proposal to Add a Spectral Density Aspect to the PCS Base Station Power Limit

As already shown, the GSM, and TDMA air interfaces use much narrower channels than the CDMA and WCDMA air interfaces. As a result, networks using the GSM and TDMA air interfaces can use many more carriers per MHz than CDMA and WCDMA networks. For example, with a reuse of one, a TDMA network can use 160 times the number of carriers that a WCDMA network can use; a GSM network can use more than 5 times the times the number of carriers than a CDMA network can use. This wide disparity in the number of carriers that various networks can use means that a base station output power rule that solely employs a per carrier limit would necessarily favor GSM and TDMA networks and disfavor CDMA and WCDMA networks, the very networks which will deliver advanced, high speed 3G services to Americans. Thus, CTIA's proposal for adoption of a spectral density aspect to the base station power limit is fully in keeping with the Commission's well-established policy of maintaining technology-neutral rules in wireless services, and to reject CTIA's proposal would impair the operations of the latest, state-of-the-art wireless technologies, thereby harming the public interest.

In another proceeding, the Commission summarized its policy of technology neutrality in wireless services as follows:

> "We also note that most of our rules governing the licensing and operation of wireless services, particularly commercial services, are technology-neutral except to the extent necessary to prevent

interference among competing spectrum uses."

In the Matter of IP-Enabled Services, Notice of Proposed Rule Making, 19 FCC Rcd 4863, 4904 (2004).

This policy of technology neutrality, adopted around the world, has enabled advanced, spectrally efficient CDMA technology to develop and flourish. This technology is now the basis for the latest generation, the third generation, of modern wireless telecommunications services. There is no reason why the Commission to disfavor systems based on this technology in its base station power limit. For these reasons, QUALCOMM urges the Commission to adopt the CTIA proposal to add a spectral density aspect to the base station power rule.

IV. The Commission Should Regulate Average Power During Transmission and Should Not Impose Any Limit on the Peak to Average Ratio

As explained herein, QUALCOMM believes that the Commission's PCS base station power limit should regulate average power during transmission and that the Commission should not impose a limit on peak to average ratio because such a limit would not reduce the potential for interference, but would reduce the transmission capacity of CDMA base stations. The reasons for this conclusion stem from fundamental aspects of CDMA technology.

Most communication systems have been designed to work in an environment in which Gaussian noise (thermal or interference) is the main limiting factor. This is the case because the Gaussian amplitude distribution models very well the distribution of the nose encountered by communication systems in general. It is an important fact that the amplitude distribution of the forward link signal of a fully loaded CDMA (CDMA2000 or WCDMA/HSDPA) base station base station is very similar to the amplitude distribution of any Gaussian noise. From this follows that the peak to average ratio ("PAPR") of a CDMA base station signal is also very similar to the PAPR of a Gaussian noise. Therefore, the PAPR of the transmit signal of a CDMA base station does not appear as an anomaly, but rather as a level similar to most other noise encountered by a victim receiver.

It is known from information theory that among all transmit waveforms of a given average power, those that have the PAPR nearest to that of the Gaussian noise have the highest capacity (i.e., the highest achievable data rate). Limiting the PAPR to a level less than that of the Gaussian noise would reduce downlink

capacity, without significantly reducing the potential impact on the victim receiver. This conclusion does not cover the impact of averaging over active and idle time slots or averaging over different periods of the day or the like because those power variations are on a time scale far greater than that of the reciprocal of the signal bandwidth and, therefore, their impact is not going to be averaged in the victim receiver.

If the peak to average ratio is high for a given air interface, a base station employing that air interface would need to reduce its average power anyway in order to meet the out-of-band emission limits. Further, it is impossible to have a constant envelope (zero peak to average ratio) band limited waveform. The known wideband waveforms designed for high data rate transmissions are tightly band limited, and, thus, cannot have a constant envelope. On the other hand, even though a waveform with a constant envelope does not spread out when it starts to overload a receiver, it cannot be tightly band limited. Consequently, even if the peak to average ratio is zero, interference at a given frequency offset will not be significantly different from the level of interference that would be caused with a higher peak to average ratio.

For these reasons, QUALCOMM asks the Commission not to adopt a limit on the peak to average ratio. QUALCOMM does believe that the average power of a base station should be measured when the base station is transmitting so as to eliminate any advantage for gated waveforms.

IV. Conclusion

Wherefore, for the foregoing reasons, QUALCOMM respectfully requests that the Commission revise Section 24.232 (a) as CTIA has proposed to add a spectral density aspect to the limit on average base station power, and the Commission should not adopt a limit on the peak to average ratio of a base station's transmissions.

Respectfully submitted,

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